(No Model.)

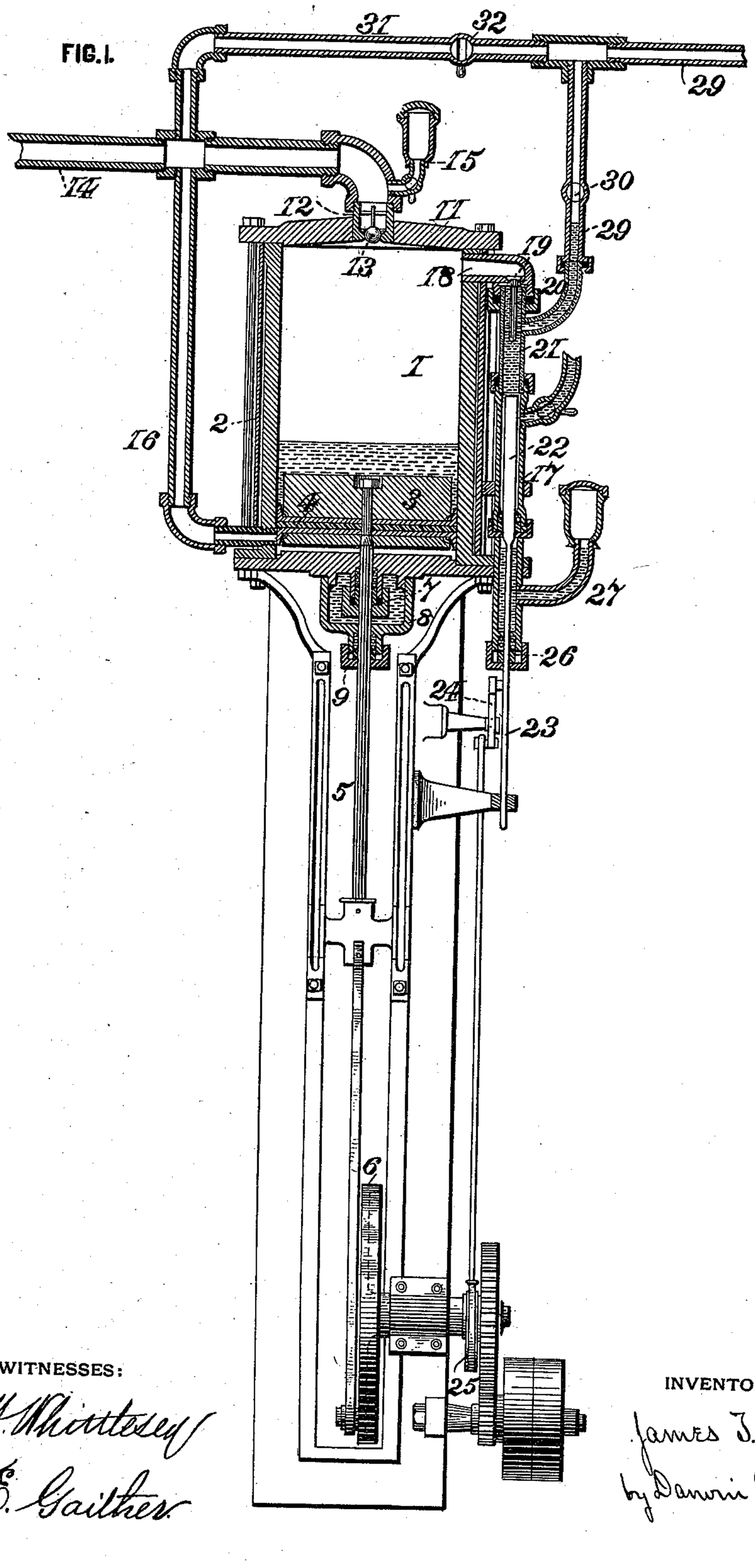
3 Sheets—Sheet 1.

J. T. HAMBAY.

VACUUM PUMP.

No. 400,668. Patented Apr. 2, 1889.

FIG. 1.



WITNESSES:

R. H. Whittlesey

F. E. Gaither

INVENTOR,

James T. Hambay

by Darwin S. Wolcott

Att'y.

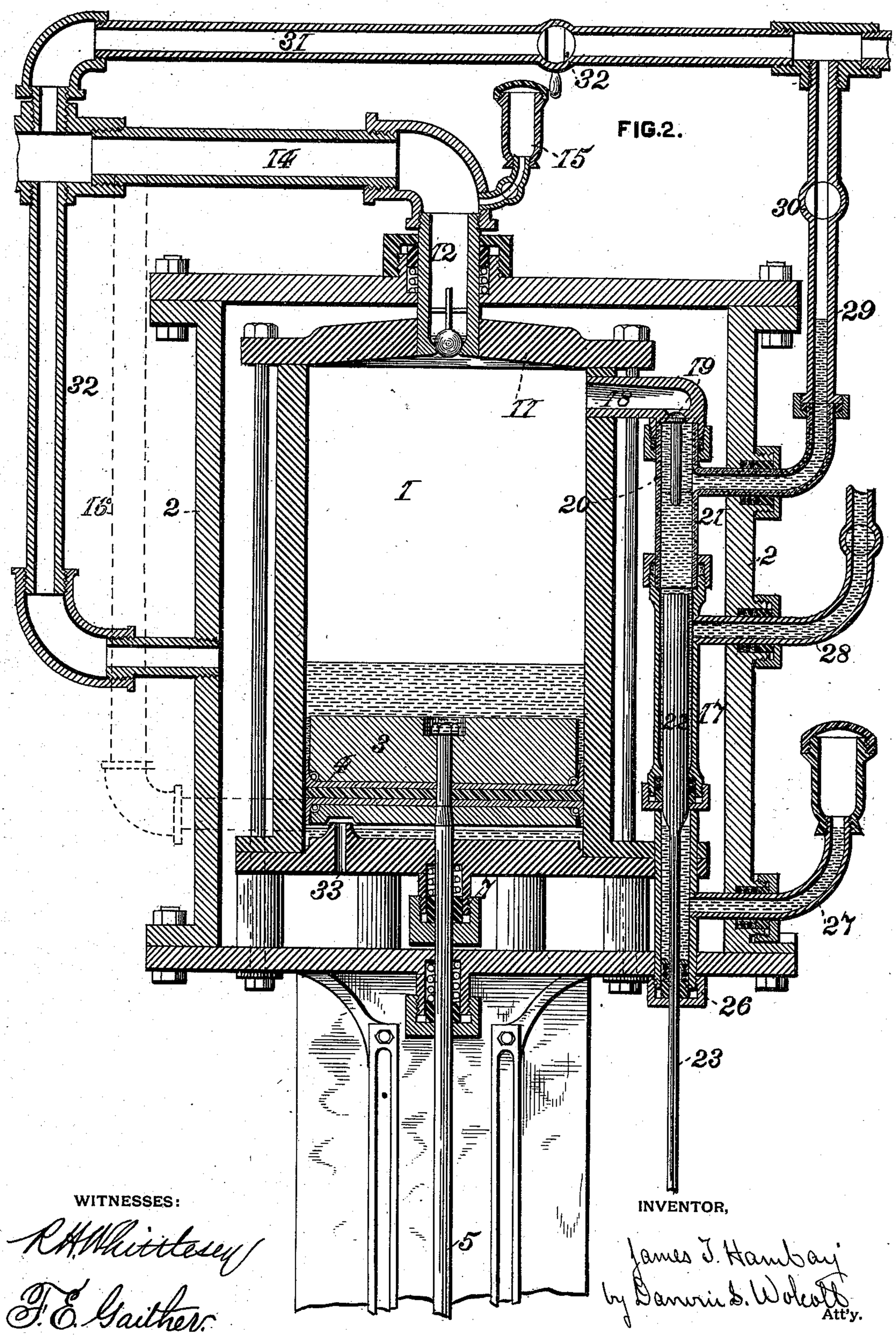
(No Model.) 3 Sheets—Sheet 2.

J. T. HAMBAY.

VACUUM PUMP.

No. 400,668. Patented Apr. 2, 1889.

FIG. 2.



WITNESSES:

R. A. Whittlesey

F. E. Gaither.

INVENTOR,

James J. Hambay

by Dawrin S. Wolcott Att'y.

(No Model.)

3 Sheets—Sheet 3.

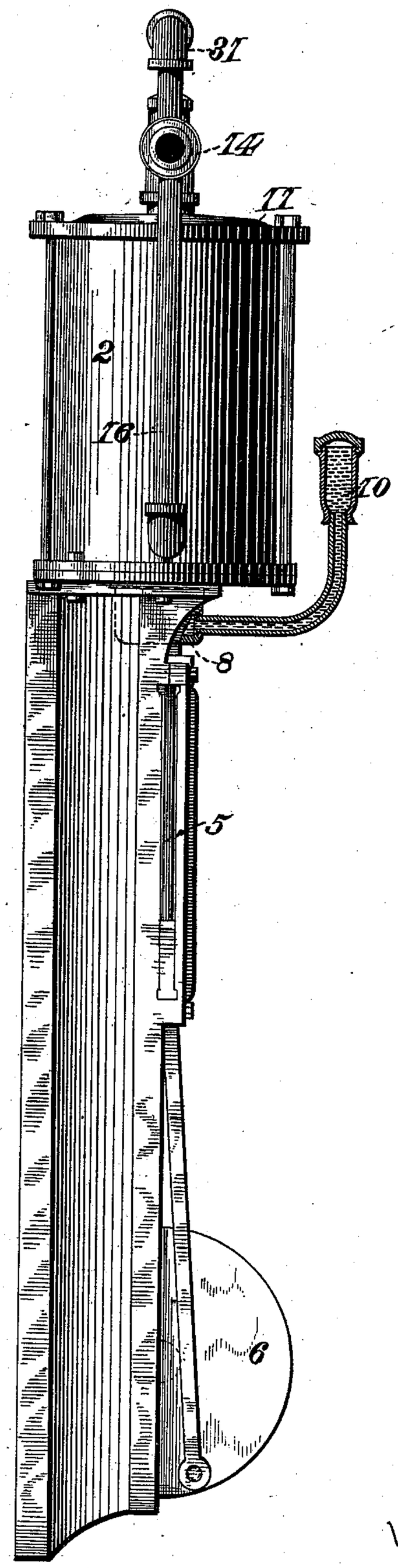
J. T. HAMBAY.

VACUUM PUMP.

No. 400,668.

Patented Apr. 2, 1889.

FIG. 3.



WITNESSES:

R. H. Whittemore

F. E. Gaither.

INVENTOR,

James T. Hambay

by Dennis & Wolcott

Att'y.

UNITED STATES PATENT OFFICE.

JAMES T. HAMBAY, OF PITTSBURG, PENNSYLVANIA.

VACUUM-PUMP.

SPECIFICATION forming part of Letters Patent No. 400,668, dated April 2, 1889.

Application filed August 3, 1887. Serial No. 246,024. (No model.)

To all whom it may concern:

Be it known that I, JAMES T. HAMBAY, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, a citizen of the United States, have invented or discovered certain new and useful Improvements in Vacuum-Pumps, of which improvements the following is a specification.

The invention herein relates to certain improvements in apparatus for the production of high vacuum—*i. e.*, above twenty-eight or twenty-nine barometric inches. The highest vacuum heretofore attainable by the use of mechanical pumps was twenty-eight or twenty-nine barometric inches; hence it has been necessary where a higher vacuum was desired to have recourse to mercurial pumps of the Sprengel or Geissler type. The capacity of these types of pumps is limited by reason of the manner in which they are constructed and operated.

The object of the invention is to provide a mechanical or power pump having such a construction and arrangement of parts that a practically perfect or high vacuum may be produced thereby; and to this end the invention consists in the construction, arrangement, and combination of parts, substantially as hereinafter more fully described and claimed.

In the accompanying drawings, forming a part of this specification, Figure 1 is a sectional elevation of my improved pump. Fig. 2 is a similar view, on an enlarged scale, of a modification thereof. Fig. 3 is a side elevation.

The cylinder 1 of the pump is of the ordinary construction found in exhaust-pumps, the body portion thereof being surrounded by a jacket or casing, 2, thus forming a space for the reception of mercury or other liquid which will exclude the air. Within the cylinder is arranged the piston 3, having a double cup-shaped packing, 4, preferably secured to the lower end of the piston, which is operated by the rod 5, connected to any suitable operating device, as the crank-disk 6. The lower cylinder-head is provided with a stuffing-box, 7, of any suitable construction, for the piston-rod, said box being surrounded by a shell, 8, attached to the cylinder-head, and also provided with a stuffing-box, 9. The chamber formed by the shell 8 is filled with mercury or other suitable liquid for the exclusion of air, said shell being connected to a reservoir, 10, for the purpose of maintaining a constant supply of fluid in the chamber.

The under side of the upper head, 11, of the cylinder is made concave, as shown, and at the apex of its concavity is inserted a hollow plug, 12, provided with a seat for the float-valve 13. Onto the plug is screwed one end of the pipe 14, leading to a continuously-operating exhaust-pump of any suitable construction. The portion of the plug 12 around and adjacent to the valve 13 is filled with mercury in order to seal the joint between the valve 13 and its seat. A suitable reservoir, 15, is connected to the pipe 14 or its plug, for the purpose of maintaining a constant supply of mercury at that point. The lower end of the cylinder below the piston is connected by a pipe, 16, to the pipe 14, leading to the continuously-operating exhaust-pump, as above described.

The cylinder 1 is connected at a point at or near its upper end to the upper end of the valve-cylinder 17 by a port or passage, 18. At the upper end of the cylinder 17 is formed a seat for the upwardly-closing valve 19, provided with a valve-stem, 20, which passes through the guide-plate 21, said plate also serving as a stop to limit the downward movement of the valve.

Within the valve-cylinder 17 is arranged a piston, 22, connected by a rod, 23, to any suitable operating mechanism—in this case a lever, 24, operated by an eccentric, 25, on the shaft carrying the crank-disk 6. The lower end of the cylinder 17 is provided with a stuffing-box, 26, surrounding the rod 23, and the lower end of said cylinder is filled with mercury from a reservoir connected thereto by the pipe 27. The portion of the cylinder 17 above the piston is also connected to a mercury-reservoir by a pipe, 28, and the upper end of the cylinder is connected by the pipe 29, having a closing-valve, 30, to the vessel or vessels which it is desired to exhaust, and the pipe 29 is connected by the pipe 31, provided with a closing-valve, 32, to the pipe 14, as shown.

In operating my improved apparatus a sufficient quantity of mercury or other suitable fluid is placed in the cylinder 1 above the

piston to not only fill the upper portion of the cylinder and the port 18 when the piston is at the upper limit of its stroke, but also to cause a certain portion to enter the plug 12, lifting the valve 13. A sufficient quantity of mercury is also placed in the cylinder 17 to fill the upper end of said cylinder and the pipe 29 adjacent thereto when the piston 22 is at the upper limit of its stroke, thereby floating the valve 19 against its seat. Air is then exhausted from the cylinder 1 and the parts connected thereto by the operation of the pump, to which the pipe 14 is connected, the vacuum thus produced being about twenty-eight barometric inches. The vessel or vessels to be exhausted are then connected to the pipe 29, and the valve 32 in the pipe 31 being opened a corresponding vacuum is produced in said vessels. As soon as the vessels have been exhausted as far as possible by the action of the pump connected to the pipe 14 the valve 32 is closed and the valve 30 in the pipe 29 opened, thereby forming communication between the pump and the vessels to be exhausted.

The movements of the pistons 3 and 22 are so adjusted relatively to each other that the piston 22 will move up ahead of the piston 1, thereby floating the valve 19 against its seat and tightly sealing the joint around said valve, thereby cutting off all communication between the cylinder 1 and the vessels to be exhausted. The piston 3 is then moved upward, carrying with it the mercury placed thereon, as above stated. As the piston 3 approaches the upward limit of its stroke, the mercury will flow into the port or passage 18 and, filling said port, expel all air therefrom. As the mercury rises in the cylinder, the air will be forced past the valve 13, and as the sides and top of the cylinder converge, as it were, to the point where the valve 13 is located, the mercury in its upward movement will sweep all the air before it and force such air past the valve 13. To insure the expulsion of all air from the cylinder, such an amount of mercury is placed in the cylinder that a portion thereof will be forced into the plug. As soon as the piston 3 has completed its upward stroke, as above described, and has moved down sufficiently far to permit the mercury in the port or passage 18 to flow back into the cylinder 1, the piston 22 moves down, thereby permitting the valve 19 to drop and opening communication between the cylinder 1 and the vessels to be exhausted, whereupon the air in said vessels and their connections will expand, filling the space in the cylinder 1 above the surface of the mercury therein.

Repeated strokes of the piston 3, as above described, will effect a practically perfect Torricellian vacuum in the vessels to be exhausted and the cylinder 1. All air forced into the pipe 14 is removed to an extent equal to the capacity of the continuously-operating pump connected to said pipe. The pressure on the under side of the piston when moving downward is relieved by the pipe 16, connecting the lower end of the cylinder 1 and the pipe 14, as shown.

In lieu of surrounding only the body portion of the cylinder with protecting jacket or shell 2, as shown in Fig. 1, the cylinders 1 and 17 may be entirely surrounded with such a jacket, shell, or cylinder, as shown in Fig. 2, said protecting-cylinder being either connected by a pipe, 32, to the pipe 14, as shown, or else filled with mercury. When the shell or cylinder is connected to the pipe 14, an opening, 33, is formed in the lower head of the cylinder 1 to permit of the escape of air therefrom during the downward stroke of the piston; but when the shell 2 is filled with mercury the cylinder 1 is connected to the pipe 14 by the pipe 16, as above described and as indicated by dotted lines.

The "strokes," as they might be called, of the Geissler and Sprengel pumps become gradually slower as the vacuum becomes higher, while in my pump the rapidity of stroke is independent of the vacuum and the capacity of the pump is far in excess of that attainable in either the Geissler or Sprengel pumps.

The mercury, which is raised and lowered in the cylinder 1 by the operation of the piston 3, acts as the fluid-piston in the Geissler form of pump, the difference between the two being that one is mechanically operated at regular intervals, whereas the other is operated irregularly by variations of fluid-pressure.

I claim herein as my invention—

1. In an apparatus for the production of high vacuums, the combination of a cylinder having a valvular connection with a continuously-operating exhaust-pump and with the vessel to be exhausted, a shell surrounding said cylinder and protecting the same as against the admission of air, except through connection with the vessel to be exhausted, and a suitably-packed piston operating in said cylinder, substantially as set forth.

2. In an apparatus for the production of high vacuums, the combination of a cylinder having a valvular connection with a continuously-operating exhaust-pump and with the vessel to be exhausted, a shell surrounding said cylinder and having pipe-connections with a continuously-operating exhaust-pump, and a suitably-packed piston operating in said cylinder, substantially as set forth.

3. In an apparatus for the production of high vacuums, the combination of a cylinder having a valved outlet, a mechanically-operated fluid-piston, a valve-chamber connected thereto and to the vessel to be exhausted, a valve for closing the connection to the cylinder, and a mechanically-operated fluid-piston for operating said valve, substantially as set forth.

4. In an apparatus for the production of high vacuums, the combination of a cylinder, a piston operating therein, a valve-chamber

having a valved connection to said cylinder, and a piston for operating said valve, the several joints, connections, and valves, when in a closed position, having a fluid seal, substantially as set forth.

5. In an apparatus for the production of high vacuums, the combination of a cylinder, the head thereof having a concave inner surface, a valved outlet located at the apex of the concave surface, a valved inlet connecting the cylinder and the vessel to be exhausted, and a mechanically-operated fluid-piston in said cylinder, substantially as set forth.

In testimony whereof I have hereunto set my hand.

JAMES T. HAMBAY.

Witnesses:
DARWIN S. WOLCOTT,
R. H. WHITTLESEY.